WE CLAIM:

1. A method for metallizing an integrated circuit, the method comprising

depositing a diffusion barrier on a substrate;

oxidizing a top layer of the diffusion barrier to form a metal oxide layer;

reducing the oxidation state of the metal oxide layer to form a first seed layer; and

depositing a conductor directly on the first seed layer.

2. The method of Claim 1, wherein depositing a diffusion barrier layer comprises an atomic layer deposition process.

3. The method of Claim 1, wherein depositing a diffusion barrier comprises depositing a metal nitride layer.

4. The method of Claim 3, wherein depositing a diffusion barrier comprises depositing a tantalum nitride layer.

5. The method of Claim 1, wherein depositing a diffusion barrier comprises depositing a metal carbide layer.

6. The method of Claim 6, wherein depositing a diffusion barrier comprises depositing a tungsten carbide layer.

7. The method of Claim 1, wherein depositing a diffusion barrier comprises depositing a metal nitride carbide layer.

8. The method of Claim 7, wherein depositing a diffusion barrier comprises depositing a tungsten nitride carbide layer.

9. The method of Claim 7, wherein depositing a diffusion barrier comprises depositing a molybdenum nitride carbide layer.

10. The method of Claim 1, wherein oxidizing the top layer of the barrier layer comprises exposing the barrier layer to an oxygen source chemical.

11. The method of Claim 10, wherein the oxygen source chemical is selected from the group comprising air, diatomic oxygen, ozone, oxygen radicals, and hydrogen peroxide.

12. The method of Claim 1, further comprising repeating oxidizing and reducing the top of the barrier layer before depositing the conductor directly on the first seed layer.

13. The method of Claim 12, wherein oxidizing and reducing the top of the barrier layer is repeated between about 10 and 50 times.

14. The method of Claim 16, wherein oxidizing and reducing the top of the barrier layer is repeated between about 20 and 40 times.

15. The method of Claim 1, wherein depositing the conductor comprises depositing a second seed layer.

16. The method of Claim 15, wherein depositing the second seed layer comprises depositing ruthenium.

17. The method of Claim 16, wherein depositing the second seed layer comprises depositing ruthenium by atomic layer deposition

18. The method of Claim 15, further comprising depositing copper directly over the second seed layer.

19. The method of Claim 1, wherein depositing a conductor comprises depositing copper.

20. The method of Claim 19, wherein depositing copper comprises an electrochemical deposition process.

21. The method of Claim 19, wherein depositing copper comprises an electroless deposition process.

22. The method of Claim 19, wherein depositing copper comprises a chemical vapor deposition (CVD) process.

23. The method of Claim 1, wherein reducing comprises reducing the metal oxide to an elemental metal form.

24. The method of Claim 1, wherein reducing the oxidation state comprises using hydrogen, hydrogen plasma, or carbon monoxide.

25. The method of Claim 1, wherein reducing the oxidation state comprises using in situ hydrogen plasma.

26. The method of Claim 1, wherein reducing the oxidation state comprises using remote hydrogen plasma.

27. The method of Claim 1, wherein reducing the oxidation state comprises an electrochemical process.

28. The method of Claim 1, wherein reducing the oxidation state of the metal oxide comprises exposing the metal oxide to a gaseous compound containing a functional from the group comprising alcohol (-OH), aldehyde (-CHO), and carboxylic acid (-COOH).

29. A method of metallizing an integrated circuit, the method comprising

forming a tungsten nitride carbide diffusion barrier on a substrate;

forming a tungsten oxide layer over the diffusion barrier;

reducing the tungsten oxide layer to form a first seed layer; and

depositing a copper layer over the first seed layer.

30. The method of Claim 29, further comprising forming a second seed layer between the first seed layer and the copper layer.

31. The method of Claim 30, wherein forming a second seed layer comprises depositing ruthenium.

32. The method of Claim 31, wherein depositing ruthenium comprises using an atomic layer deposition process.

33. A method for metallizing an integrated circuit, the method comprising

forming a diffusion barrier layer on a substrate;

performing a preparation process on the substrate to form a nucleation layer;

repeating the preparation process on the substrate n times, wherein $n = \{0,1, 2,...\}$;

depositing a conductor over the nucleation layer to form a seed layer; and

depositing copper over the seed layer.

34. The method of Claim 33, wherein depositing the conductor comprises depositing ruthenium.

35. The method of Claim 33, wherein depositing the conductor comprises depositing a metal by atomic layer deposition.

36. The method of Claim 33, wherein the preparation process comprises:

exposing the substrate to a pulse of oxygen in a reactor chamber;

purging the reactor chamber with an inert gas;

exposing the substrate to a pulse of hydrogen; and

purging the reactor chamber with an inert gas.

37. The method of Claim 36, further comprising exposing the substrate to a pulse of a ruthenium source chemical and purging the reactor chamber before exposing the substrate to the oxygen pulse.

38. The method of Claim 36, wherein the oxygen pulse lasts less than 60 seconds.

39. The method of Claim 36, wherein the hydrogen pulse lasts less than 60 seconds.

40. The method of Claim 38, wherein the oxygen pulse lasts between about 5 and 40 seconds.

41. The method of Claim 39, wherein the hydrogen pulse lasts between about 5 and 40 seconds.

42. The method of Claim 40, wherein the oxygen pulse lasts between about 10 and 30 seconds.

43. The method of Claim 41, where the hydrogen pulse lasts about 10 and 30 seconds.

44. The method of Claim 36, wherein exposing the substrate to the hydrogen pulse comprises exposing the substrate to in situ hydrogen plasma.

45. The method of Claim 36, wherein exposing the substrate to the hydrogen pulse comprises exposing the substrate to remote hydrogen plasma.

46. The method of Claim 33, wherein forming the diffusion barrier comprises depositing tungsten nitride carbide.

47. The method of Claim 33, wherein forming the diffusion barrier comprises depositing molybdenum nitride carbide.

48. The method of Claim 33, wherein n is less than or equal to 100.

49. The method of Claim 48, wherein n is between about 10 and 50.

50. The method of Claim 49, wherein n is between about 20 and 40.

51. The method of Claim 33, wherein depositing the copper comprises electrochemical deposition.

52. The method of Claim 33, wherein depositing the copper comprises chemical vapor deposition.

53. A metallization structure in an integrated circuit, the structure comprising

a diffusion barrier including a metal, the diffusion layer deposited by atomic layer deposition (ALD);

a nucleation layer directly over the diffusion barrier, wherein the nucleation layer is formed from the metal in the diffusion barrier; and

a ruthenium seed layer deposited by ALD over the nucleation layer.

54. The structure of Claim 53, further comprising a copper layer directly over the ruthenium seed layer.

55. A metallization structure in an integrated circuit, the structure comprising

a diffusion barrier;

a first seed layer directly over the diffusion barrier formed from the same metal as the diffusion barrier;

a copper layer over the first seed layer.

56. The structure of Claim 55, further comprising a chemical mechanical polishing stop layer below at least part of the diffusion barrier area.

57. The structure of Claim 55, wherein the diffusion barrier is deposited by atomic layer deposition.

58. The structure of Claim 55, wherein the copper layer is directly over the first seed layer.

59. The structure of Claim 55, further comprising a second seed layer positioned between the first seed layer and the copper layer.

60. The structure of Claim 59, wherein the second seed layer comprises a ruthenium layer.

61. The structure of Claim 59, wherein the second seed layer has a step coverage ratio of higher than about 95%.

62. The structure of Claim 59, wherein the second seed layer has a step coverage ratio of higher than about 97%.